ANDIDATE'S
NUMBER

(For the use of the Department only)

Tests
D-2.1

Physics 30
1965

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DEPARTMENT EDUCATION ALBERTA

HIGH SCHOOL AND UNIVERSITY MATRICULATION

EXAMINATIONS BOARD

DEPARTMENTAL EXAMINATIONS, 1965

PHYSICS 30

Time — 3 hours.

Total Possible Mark — 149

DO NOT SPEND TOO MUCH TIME ON ANY ONE QUESTION.
READ THE QUESTIONS CAREFULLY.

Mathematical tables, slide rules and geometry sets may be used.

Complete solutions must be shown for all problems.

Some of the problems may be solved by scale diagrams.

Rough and finished work may be done in pencil or ink (Blue or Black).

DO NOT FOLD THIS BOOKLET.

Place your test booklet in the answer envelope in such a way that the UPPER LEFT HAND CORNER OF THE BOOKLET (Candidate's Number) shows through the SLASHED CORNER of the answer envelope.

BE SURE TO SEAL THE ENVELOPE.

Constants:

$\pi = 3.14$

$J = 778$ ft lb wt/BTU

$g = 980$ cm/sec^2 or 32 ft/sec^2

1 HP = 550 ft lb wt/sec

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CURR HIST

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ROUGH WORK ONLY

(No marks given for work in this space)

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QUAECUMQUE VERA

Values

5 **1.** A car driver is making a 200 mile trip. If his average speed for the first 100 miles is 40 mph, what must his average speed be for the last 100 miles if the average speed for the entire trip is to be 50 mph?

2. Somewhere there is a river which is 1 mile wide and whose banks are parallel to one another. The water flows parallel to the banks at a rate of 3 mph. A man who can row a boat at a steady speed of 5 mph in still water wants to cross the river.

1 (a) In what direction should he aim the boat in order to cross the river in the shortest possible time?

2 (b) What is this shortest possible time?

4 (c) If he insists upon landing directly opposite his starting point, how long would the trip take?

ROUGH WORK ONLY

(No marks given for work in this space)

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Values

2 **3.** (a) A car started from rest and accelerated at a constant rate. If it took 20 sec to travel $\frac{1}{4}$ mile (1320 ft), what was the acceleration?

2 (b) How long did it take this car to reach 60 mph from rest?

2 (c) If the car weighs 3200 lb wt, what force was required to produce this acceleration?

2 (d) How many horsepower was the car's engine developing at 60 mph? (Neglect frictional losses.)

2 (e) What was the kinetic energy of the car when it was travelling at 60 mph?

2 (f) How much work was done in accelerating the car from rest to 60 mph?

2 (g) What was the momentum of the car when it was travelling at 60 mph?

ROUGH WORK ONLY

(No marks given for work in this space)

Values

4 **4.** A coin is projected horizontally off the edge of a table top. The table top is horizontal and is 4 ft above the floor. The coin strikes a spot on the floor 5 ft away from the side of the table. How fast was the coin moving when it left the table?

3 **5.** Explain why a person cannot lift himself up by pulling upwards on his bootstraps?

ROUGH WORK ONLY

(No marks given for work in this space)

Values

6. An inclined plane is 12 ft long along the incline and 3 ft high at one end.

2 (a) What force applied parallel to the plane is required to slide a box weighing 200 lb wt up the plane at a constant speed, if friction is neglected?

1 (b) What is the mechanical advantage of the plane?

3 (c) What is the efficiency of the plane if a force of 75 lb wt is required to slide the box up the plane at constant speed?

ROUGH WORK ONLY

(No marks given for work in this space)

Values

3 **7.** Must the center of gravity of an object always be located at a point within the material of the object? Give an example to support your answer.

5 **8.** A uniform rod 100 cm long has a mass of 2000 grams. A mass of 1000 grams is placed at one end and a 3000 gram mass is placed at the other end. Find the position of the center of gravity of the loaded rod. Draw a diagram showing its location.

3 **9.** The highway safety people tell us that the fastest way to stop a car is to apply the brakes in such a way that the wheels of the car are just on the verge of, but not actually, slipping. What is the reason for their statement?

ROUGH WORK ONLY

(No marks given for work in this space)

Values

4 **10.** (a) A car weighing 3600 lbs and travelling at 60 mph strikes the rear of a truck weighing 40,000 lbs and travelling in the same direction at 40 mph. If the two vehicles stick together after the impact, what is their speed?

2 (b) Why is it safer in case of a collision, such as this one, to be in the heavier vehicle?

2 **11.** (a) A pendulum consists of a bob attached to one end of a string 2 ft long. The other end of the string is held fixed. What length of time is required for one complete oscillation of the pendulum?

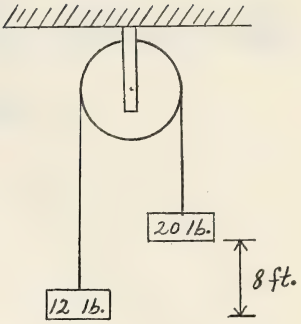
2 (b) What would happen if the entire pendulum assembly were in a freely falling elevator?

ROUGH WORK ONLY

(No marks given for work in this space)

Values

12. Two objects, one of 12 lbs and the other of 20 lbs, hang from either end of a string which passes over a frictionless pulley. When the system is released from rest the vertical distance between the two objects is 8 ft.



3 (a) What is the acceleration of the system?

4 (b) What is the tension in the string?

3 (c) How long does it take until both weights are the same distance above the floor?

3 **13.** What is the difference between mass and weight? Does the value obtained for either mass or weight depend upon the location of the place where it is measured?

ROUGH WORK ONLY

(No marks given for work in this space)

Values

14. A rectangular block whose mass is 100 grams rests on a plane inclined at an angle of 30° to the horizontal. The coefficient of friction between the block and the plane is 0.15.

4 (a) What is the acceleration of the block down the incline?

2 (b) In part (a) is mechanical energy conserved when the block slides down the plane? Give a reason for your answer.

2 (c) What is the minimum force, applied parallel to the plane, required to stop the block from sliding down the incline?

4 (d) What is the force, applied parallel to the plane, required to move the block up the incline at a constant speed?

[OVER]

ROUGH WORK ONLY

(No marks given for work in this space)

Values

15. A copper cube has edges that are 10.0000 cm long when the temperature of the block is 20° C. The temperature of the block is then raised to 100° C. The coefficient of linear expansion for copper is 0.000017 per °C.

2 (a) What is the length of each edge at 100° C?

2 (b) What is the area of each face at 100° C?

2 (c) What is the volume of the cube at 100° C?

6 **16.** Calculate the heat of fusion of ice from the following data.

Mass of calorimeter	50 grams	Initial temperature of water	35° C
Mass of calorimeter plus water	445 grams	Initial temperature of ice	0° C
Mass of calorimeter plus water plus ice	545 grams	Final temperature of mixture after ice has melted	12.5° C
		Specific heat of calorimeter	0.10

ROUGH WORK ONLY

(No marks given for work in this space)

Values

3 **17.** The value of the symbol "J" is given on the first page of this examination. What important principle does it express in quantitative form? Who first enunciated this principle?

5 **18.** (a) The paddles of a churn are driven by a motor which is supplying 0.75 HP to the paddles. If the churn is filled with 10 gal of water, how long will it take to raise the temperature of the water 10° F assuming that all the work done goes into heating the water? (One gallon of water weighs 10 lb wt.)

2 (b) If the original temperature of the water was 65° F, what is the final temperature in °C?

ROUGH WORK ONLY

(No marks given for work in this space)

Values

3 **19.** Two point charges of unknown magnitude and unknown sign are placed a distance d apart. What conclusion can be drawn about the charges if it is found that the electric field strength is zero at one point along the line joining the two charges and between them?

8 **20.** Three small spheres carrying electric charges of +10, +5 and –5 electrostatic units are placed at the vertices of an equilateral triangle having sides of 10 cm. Find the magnitude and direction of the resultant force exerted on the +10 unit charge by the other two. Draw a diagram showing clearly how the charges are placed as well as each force acting on the +10 unit charge. Also indicate on the diagram how the forces are summed to get the resultant force.

ROUGH WORK ONLY

(No marks given for work in this space)

Values

3 **21.** (a) The quantity of electricity needed to liberate one gram-equivalent of any substance is a constant and is called the faraday. From the following information calculate the value of the faraday in coulombs. The atomic weight of copper is 63.6 grams, its valence is 2, and the electro-chemical equivalent for copper is 0.00033 gram per coulomb.

2 (b) The charge on an electron is 1.60×10^{-19} coulomb. How many electron charges are there in a faraday?

1 (c) The result for part (b) is a physical constant. What is the name of this constant?

ROUGH WORK ONLY

(No marks given for work in this space)

Values

3 **22.** (a) Three resistors whose resistances are R_1, R_2, and R_3 ohm are connected in series. Derive a formula for the equivalent resistance of this series circuit. (Draw diagrams for both parts of this question.)

4 (b) The same three resistors are now connected in parallel. Derive a formula for the equivalent resistance of this parallel connected circuit.

ROUGH WORK ONLY

(No marks given for work in this space)

Values

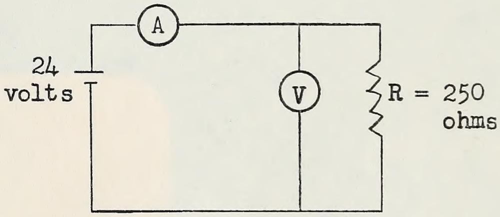
23. A battery whose EMF is 24.0 volts has a negligible internal resistance and is connected across a resistor whose resistance is 250 ohms.

1 (a) What is the voltage drop across the resistor?

2 (b) What current flows through the resistor?

2 (c) At what rate is heat being produced in the resistor?

4 (d) In an attempt to measure the current through the resistor as well as the voltage across it the electrical circuit shown in the diagram was used. The voltmeter, V, had a resistance of 1000 ohms while that of the ammeter, A, was 40 ohms. What current would be indicated by the ammeter?



[OVER]

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ROUGH WORK ONLY

marks given for work in this space)

LB 3054 C2 D419 1965 phy.30
Departmental examinations,
[grade 12] 1965. -

39780815 CURR HIST

Values

4 (e) What voltage would be indicated by the voltmeter?

2 (f) Under these conditions what is the current flowing through the 250 ohm resistor?

3 (g) What conclusion do you draw from the result of these calculations?